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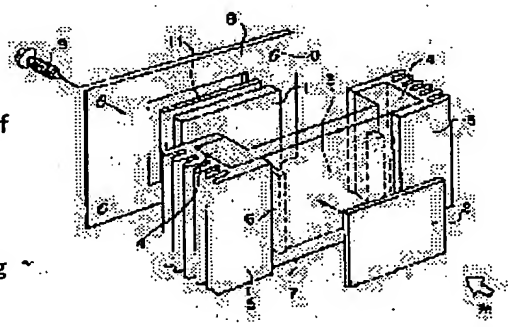
## (54) COOLER OF LIQUID CRYSTAL PROJECTOR

(57)Abstract:

PURPOSE: To provide a cooler of a liquid crystal projector which is small and inexpensive and has a decreased difference in cooling effect between the upper and lower parts of a liquid crystal panel.

CONSTITUTION: The cooling liquid housing container 7 of the cooler of the liquid crystal projector formed by arranging the cooling liquid housing container 7 between the liquid crystal panel and a polarizing plate and packing a cooling liquid therein has a sheet-shaped cooling part space 3 of a shape to cover one surface of the liquid crystal panel 1 and cooling-liquid circulating part spaces 4 at both right and left ends thereof. The cooling liquid circulating part spaces 4 and the cooling part space 3, exclusive of the upper and lower parts are partitioned. At least the cooling liquid housing container 7 is transparent in the part forming the cooling part space 3 and is in tight contact with the liquid crystal panel 1. Heat radiating fins 5 are mounted in the cooling liquid circulating part space 4. The circulation of the cooling liquid is smooth and a high cooling effect is maintained over a long period of time if the cooler is constituted in such a manner.



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## CLAIMS

[Claim(s)]
[Claim 1] The liquid crystal panel which projects an image by making the light supplied through the polarizing plate penetrate, The coolant is held in the interior of the coolant hold container arranged between said polarizing plates. It is the cooling system of the liquid crystal projector which cools said liquid crystal panel by absorbing the heat generated with said liquid crystal panel. Said coolant hold container one field of said liquid crystal panel in a wrap configuration Sheet-like cooling section space, Have the cooling-fluid-flow section space arranged to the right-and-left ends of said cooling section space, said cooling-fluid-flow section space and said cooling section space are divided except for the upper part and the lower part, and said coolant hold container is transparent in the part which forms said cooling section space at least. The cooling system of the liquid crystal projector characterized by for one field of the periphery section of said cooling section space having stuck with said liquid crystal panel, and equipping the periphery section of the cooling-fluid-flow section space of said coolant hold container with the radiation fin.
[Claim 2] The cooling system of the liquid crystal projector according to claim 1 characterized by the field of another side of the periphery section of the cooling section space of said coolant hold container having stuck with said polarizing plate.
[Claim 3] The cooling system of the liquid crystal projector according to claim 1 or 2 characterized by said coolant hold container consisting of resin which is transparent and is supple.

[Translation done.]

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## DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] About the cooling system of a liquid crystal projector, even if especially this invention carries out long duration operation of the liquid crystal projector, it relates to the cooling system of the liquid crystal projector which can maintain sufficient cooling effect.
[0002]

[Description of the Prior Art] A liquid crystal projector is equipment which projects the screen of a liquid crystal panel on a screen. If the structure is explained briefly, incidence of the light from the light source is carried out to a liquid crystal panel, and it has become the structure by which the light which carried out incidence penetrates a liquid crystal panel, and an image is projected on a screen. Moreover, incidence of the light from the light source may be carried out through a condenser lens or a reflecting mirror if needed. By the way, among the components of the light from the light source, on the object which projects an image, infrared components other than a visible ray etc. cause [ of a liquid crystal panel ] overheating, when it is a component without the need. For this reason, since a polarizing plate is minded, unnecessary infrared radiation etc. is removed and the light from the light source is attenuated, generally the approach of carrying out incidence to a liquid crystal panel is taken.

[0003] Even if it uses a polarizing plate as mentioned above, the temperature rise of the liquid crystal panel by transparency of light is not avoided. For this reason, overheating of a liquid crystal panel needed to be prevented. Moreover, what stuck the polarization film is used for plates, such as glass, as a polarizing plate in many cases, and if a polarizing plate is overheated, the problem of a film exfoliating will also be generated. For this reason, not only a liquid crystal panel but cooling of a polarizing plate was required. In order to prevent overheating of such a liquid crystal panel or a polarizing plate conventionally, the clearance was prepared between the liquid crystal panel and the polarizing plate, and the approach of slushing air into the clearance compulsorily and cooling was taken.

[0004]

[Problem(s) to be Solved by the Invention] However, by the air-cooling method which slushes air into the clearance between the above liquid crystal panels and polarizing plates, the problem that the above-mentioned clearance tends to be covered with dust, dust, etc. occurs. This is because dust, dust, etc. in the air which static electricity tends to collect and slushes tend to gather in the above-mentioned clearance. If dust and dust are naturally beforehand removed from the air used for air cooling, the above-mentioned problem will not be generated, but since the cold open air is introduced practical and the air is passed, even if it installs a metaphor air filter, it is difficult [ it ] to eliminate mixing of dust, dust, etc. thoroughly. Moreover, there are also problems, such as a problem of the noise by the fan who uses in order to slush air, and a fan's life.

[0005] Moreover, the miniaturization of a liquid crystal projector is demanded in recent years, and it is in the inclination for the clearance between a liquid crystal panel and a polarizing plate to become narrow inevitably. For this reason, cooling effect sufficient by the conventional air-cooling method is no longer acquired. Since a light filter may bend or it may separate when the liquid crystal panel of the color whose need is increasing especially in recent years consists of a liquid crystal film with which liquid crystal was stored, and a light filter stuck to this and temperature rises, cooling of a liquid crystal panel is more important. For this reason, a cooling system of the high liquid crystal projector of the cooling effect was desired by the twist space-saving replaced with the above-mentioned air-cooling method.

[0006] Then, you change to an air-cooling method and the cooling system which used the coolant as the cooling medium is making it propose as a high cooling system of the cooling effect by space-saving recently (for example, JP,5-107519,A). Since coolant, such as water, has high heat capacity compared with air, the advantage of the equipment using such coolant is in the point which can narrow the clearance between a liquid crystal panel and a polarizing plate the top where cooling effectiveness is high compared with an air-cooling method. Moreover, there is no problem of the noise by the fan and there is also no problem of a fan's life.

[0007] The cooling system which used the above-mentioned coolant as the cooling medium is explained briefly. Drawing 7 was carried by the above-mentioned official report, the coolant of the specified quantity is filled up with and sealed at the coolant hold container 14 produced with the transparence resin sheet with which the structure of this cooling system is supple (the sign is changed), this is arranged between a polarizing plate 13 and a liquid crystal panel 12, and a radiation fin 15 is further arranged on the side edge section of the coolant hold container 14. And when a liquid crystal panel 12

heats, it is a thing of the ability to absorb the heat by the coolant and make heat emit outside from a radiation fin 15 further.

[0008] However, there were the following problems also with the cooling system using such coolant. A liquid crystal projector is usually vertical, or since it is equipment which projects a screen on the screen put on the condition near it, the liquid crystal panel is in length or the condition near it during the activity structurally. On the other hand, although the coolant absorbs heat from a liquid crystal panel and carries out a temperature rise, the coolant with the upper part of the coolant hold container 14 and temperature low [ the coolant naturally heated ] moves to the lower part. Under the present circumstances, although the coolant circulates to some extent by the convection current, if the long duration activity of the liquid crystal projector is carried out, circulation of the coolant will become imperfection and elevated temperature cooling water will pile up in the upper part. If it becomes like this, the problem that upside cooling will become imperfection will occur.

[0009] The coolant can be agitated as this cure or how to circulate the coolant compulsorily can be considered by installing a pump. However, since the device which carries out forced circulation is made to install, and there is nothing if it is ****, when raising the cost of a liquid crystal projector, the tooth space which arranges said device is also needed not a little, and there is a problem that a liquid crystal projector will become large. Moreover, there is also a problem of the noise by said device.

[0010]

[Means for Solving the Problem] In view of this situation, this invention was made, as a result of inquiring wholeheartedly, the object is small and cheap and the difference of the cooling effect in the upper and lower sides of a liquid crystal panel is to offer the cooling system of few liquid crystal projectors. Namely, the liquid crystal panel which projects an image because this invention makes the light supplied through the polarizing plate penetrate, The coolant is held in the coolant hold container arranged between said polarizing plates. It is the cooling system of the liquid crystal projector which cools said liquid crystal panel by absorbing the heat generated with said liquid crystal panel. Said coolant hold container one field of said liquid crystal panel in a wrap configuration Sheet-like cooling section space, Have the cooling-fluid-flow section space arranged to the right-and-left ends of said cooling section space, said cooling-fluid-flow section space and said cooling section space are divided except for the upper part and the lower part, and said coolant hold container at least is transparent in the part which forms said cooling section space. It is the cooling system of the liquid crystal projector characterized by for one field of the periphery section of said cooling section space having stuck with said liquid crystal panel, and equipping the periphery section of the cooling-fluid-flow section space of said coolant hold container with the radiation fin.

[0011] Moreover, the cooling section space of said coolant hold container has stuck said polarizing plate, and also offers the cooling system of the liquid crystal projector which can also make a polarizing plate cool. In the cooling system of such a liquid crystal projector, said coolant hold container is transparent and desirable in it being a supple product made of resin.

[0012]

[Function] Drawing 1 is the explanatory view showing the cooling system of the liquid crystal projector of this invention, drawing 2 is the side elevation (only the coolant hold container 7, the batch 6, and the radiation fin 5 are drawn) which looked at the cooling system of drawing 1 from [ of light ] incidence, and drawing 3 is the flat-surface sectional view of the A-A' part of drawing 2 . The cooling system of the liquid crystal projector of this invention is explained referring to drawing 1 -3. The coolant hold container 7 is stuck to the liquid crystal panel 1, as shown in drawing 3 , and during operation of a liquid crystal projector, even if a liquid crystal panel 1 is heated, the coolant with which the coolant hold container 7 was filled up absorbs heat. The absorbed heat is missed outside through a radiation fin 5. In addition, the coolant hold container 7 is transparent in the part of the cooling section space 3 at least, and covers the light supplied from the light source.

[0013] If operation of a liquid crystal projector is started, a liquid crystal panel 1 and a polarizing plate 2

will be heated, and the temperature of the coolant in the cooling section space 3 will rise. Then, since the temperature of the coolant in the cooling section space 3 rises, the coolant moves the coolant to the upper part from a lower part. However, the cooling section space 3 is connected with the cooling-fluid-flow section space 4 in the upper part and the lower part, and the coolant collected on the upper part with high temperature is washed away in the cooling-fluid-flow section space 4. In this way, the coolant moves, as an arrow head shows the surroundings of a batch 6 to drawing 2 .

[0014] And the cooling-fluid-flow section space 4 is equipped with the radiation fin 5 as shown in drawing 1 . Therefore, although caudad washed away with the cooling water which flows from the upper part by the coolant in the cooling-fluid-flow section space 4, since heat emits from a radiation fin 5 in connection with this, a low-temperature temperature gradient is formed from an elevated temperature downward from a top at the coolant in the cooling-fluid-flow section space 4. With the pressure of the cooling water which flows from this temperature gradient and the upper part, the coolant in the cooling-fluid-flow section space 4 flows from a top to the bottom smoothly, and flows into it from the lower part in cooling section space. Thus, since cooling water circulates smoothly, even if it operates long duration and a liquid crystal projector, while the cooling effect has been high, it can maintain.

[0015] Although the liquid crystal panel 1 is stuck with the periphery section of cooling section space, as shown in drawing 3 , it is sticking a polarizing plate 2, and it also becomes possible to cool a polarizing plate 2 at the same time it cools a liquid crystal panel 1.

[0016] Moreover, the coolant hold container 7 concerning this invention is transparent, and it is desirable that it is a supple product made of resin. In made of resin, it is because adhesion with a liquid crystal panel 1 or a polarizing plate 2 becomes good. Moreover, the coolant with which the coolant hold container 7 is filled up can use solvents, such as a fluorine compound besides water.

[0017]

[Example]

The cooling system of the liquid crystal panel concerning this invention is explained concretely, referring to example drawing 1 -6. This example explains as an example the liquid crystal projector which used the liquid crystal panel of the field size of 76.2mm of longitudinal directions, and 57.0mm of lengthwise directions. In addition, the cooling property demanded is that dispersion in temperature distribution [ in / using the metal-hydride discharge lamp of 200W as the light source / by continuous running of several hours / 60 degrees C or less of attainment maximum temperatures of a liquid crystal panel and liquid crystal pummel ] is **5 degrees C under a room temperature. In addition, in the conventional cooling system (air-cooling method), only 65 degrees C or less of attainment maximum temperatures and the cooling property that dispersion in temperature distribution is **8 degrees C were acquired.

[0018] In the 1st example, the coolant hold container 7 was produced with the hot seal (how to heat and carry out joining) using the transparent polyester sheet (25 micrometers in thickness). Moreover, using the polyester sheet (1mm in thickness), heat welding was carried out and it attached in the batch 6 at the position in the coolant hold container 7. On the occasion of production of the coolant hold container 7, after filling up the coolant hold container 7 with the coolant (commercial fluorine system inactive material, trade name FURORINATO Sumitomo 3M make), heat welding was carried out and it sealed.

[0019] The coolant hold container 7 (the interior is filled up with the coolant) produced as mentioned above was equipped with the radiation fin 5 (product made from a pure copper) of a block type as shown in drawing 1 . Subsequently, as shown in drawing 1 , the installation frame 8 and the radiation fin 5 were fixed to the installation frame 8 for the polarizing plate 11 and the liquid crystal panel 1 with installation and a screw 9. In addition, in this example, the polarizing plate 11 which lets the light after penetrating the liquid crystal panel 1 besides the polarizing plate 2 which lets the light which carries out incidence to a liquid crystal panel 1 pass pass is also installed. moreover, the 1st example -- setting -- the touch area of the coolant hold container 7 and a liquid crystal panel 1 -- about 4343 -- mm2 it is -- a thing -- receiving -- the touch area with a radiation fin 5 -- about 6400 -- mm2 it is .

[0020] By the way, although the field of the liquid crystal panel 1 which touches the coolant hold

container 7, and a polarizing plate 2 is a glass plate, since the coolant hold container 7 was produced with the polyester sheet of thin meat, the liquid crystal panel 1, the polarizing plate 2, and the coolant hold container 7 were able to be stuck with the pressure of the internal coolant. Moreover, the contact surface of a radiation fin 5 and the coolant hold container 7 is also stuck with the pressure of the coolant. Moreover, in this example, in order to measure the temperature of a liquid crystal panel 1, the temperature sensor was attached in the field of the liquid crystal panel 1 which is in contact with the coolant hold container 7 (not shown). The installation location was two places, to the longitudinal direction, is a central location mostly and was attached in the location of 5mm from under 5mm from a top to the lengthwise direction. It is near the installation location (location of a top to 5mm) of the former of said sensor that temperature becomes high most on a liquid crystal panel, and an attainment maximum temperature can be substantially known by measuring the temperature of this location.

[0021] In addition, although it is selection of the thickness of the polyester sheet used for production of the coolant hold container 7, if too not much thick, when it will be bad and adhesion with a liquid crystal panel 1 or a polarizing plate 2 will become [ the thermal resistance in the contact surface ] large, the thermal resistance of the polyester sheet itself also becomes large. When too thin, reinforcement becomes less insufficient on the other hand. By this example, the polyester sheet with a thickness of 25 micrometers was chosen from the above viewpoint.

[0022] In the above-mentioned configuration, the operation test (2 hours) of a liquid crystal projector was performed under the room temperature. Consequently, the temperature rise of the liquid crystal panel 1 by the light supplied from the light source was absorbed by the coolant in the cooling section space 3, the heated coolant moved to the cooling-fluid-flow section space 4 smoothly, and it checked that heat was emitted outside from a radiation fin 5. The temperature measured with the temperature sensor attached in the liquid crystal panel 1 was 55 degrees C or less, and the upper and lower sides of this temperature were almost eternal by operation of 2 hours. Moreover, the up-and-down temperature gradient was 5 degrees C or less. Thus, the circulation of the coolant of cooling having been stable over long duration is smooth and the result of being stable over long duration.

[0023] The 2nd example is the same as the 1st example the point using radiation-fin 5' by the offset fin (product made from pure aluminium) as changed to the radiation fin 5 in the 1st example and shown in drawing 4 , the point of having changed the configuration of a coolant hold container as shown in drawing 4 , and except having fixed the installation frame 8 to radiation-fin 5' with the binder. In addition, radiation-fin 5' made from an offset fin has the advantage that it is cheap and lightweight compared with the block made from a pure copper. Also in the 2nd example, the touch area of radiation-fin 5' and a liquid crystal panel 1 was made to be the same as that of 2 and the 1st example about 6400mm (naturally the touch area with coolant hold container 7' is the same as the 1st example). Moreover, the temperature sensor was attached in the same location as the 1st example (not shown).

[0024] the temperature rise of the liquid crystal panel 1 by the light supplied like the case of the 1st example as a result of performing the operation test in the 2nd example like the 1st example -- cooling section space 3' -- it was absorbed by the inner coolant, the heated coolant moved to cooling-fluid-flow section space 4' smoothly, and it checked that heat was emitted outside from radiation-fin 5'. The temperature measured with the temperature sensor was 60 degrees C or less, and the upper and lower sides of this temperature were almost eternal in 2 hours. Moreover, the up-and-down temperature gradient was 5 degrees C or less. It turns out that the 2nd example had stable cooling over long duration although the temperature of a liquid crystal panel 1 became high a little compared with the 1st example. The circulation of the coolant of this is smooth and the result of being stable over long duration.

[0025] The example of the example comparison of a comparison is the same as that of the 1st example of the above except a point without the batch 6 in the 1st example of the above. By operation of 2 hours, eventually, it became 75 degrees C or more in the top, and the temperature measured with the temperature sensor attached up and down like the 1st example became about 65 degrees C in the bottom, although the upper and lower sides have maintained 65 degrees C or less in the early stages of

operation (an up-and-down temperature gradient is 10 degrees C or more). Thus, the cooling property worsened compared with the 1st example and 2nd example. This is the result of circulation of the coolant being overdue.

[0026]

[Effect] As explained in full detail above, the cooling system of the liquid crystal projector of this invention is smooth and the thing which enables circulation stabilized over long duration of the coolant with small and simple structure, without requiring an expensive device like the churning (circulation) equipment of the coolant. Thus, this invention offers the cooling system of the small and cheap liquid crystal projector which cools a liquid crystal panel and a polarizing plate efficiently, and the contribution on the industry is remarkable.

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is the decomposition perspective view showing one example of the cooling system of the liquid crystal projector concerning this invention.

[Drawing 2] It is the explanatory view of the cooling system of the liquid crystal projector of drawing 1 showing the migration situation of the coolant with the side elevation of an abbreviation in part.

[Drawing 3] It is the flat-surface sectional view of the A-A' section of drawing 2 .

[Drawing 4] It is the decomposition perspective view showing other examples of the cooling system of the liquid crystal projector concerning this invention.

[Drawing 5] It is the explanatory view of the cooling system of the liquid crystal projector of drawing 4 showing the migration situation of the coolant with the side elevation of an abbreviation in part.

[Drawing 6] It is the flat-surface sectional view of the B-B' section of drawing 5 .

[Drawing 7] It is the decomposition perspective view showing the cooling system of the conventional liquid crystal projector.

[Description of Notations]

1 Liquid Crystal Panel
2 Polarizing Plate
3 and 3' cooling section space
4 and 4' cooling-fluid-flow section space
5 and 5' radiation fin
6 and 6' batch
7 and 7' coolant hold container
8 Installation Frame
9 Screw
10 Screw Insertion Hole

11 Polarizing Plate
12 Liquid Crystal Panel
13 Polarizing Plate
14 Coolant Hold Container
15 Radiation Fin
16 Installation Frame

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[Translation done.]